Supplementary Information:
Oxide Ion Conduction Anisotropy Deconvoluted in Polycrystalline Apatite-Type Lanthanum Silicates

Yong Kim,[a] Dong-Kyu Shin,[a] Eui-Chol Shin,[a] Hyun-Ho Seo,[a] Jong-Sook Lee*[a]

The following tables and figures are the impedance analysis with a single $R-CPE$ parallel circuit model to be compared with the analysis done using two resistor models in the hierarchical connection reported in the main paper.

Table. S 1 Fit results for the spectra in Figs. S3,S1,S5 of the sample with x=-0.5 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ using the equivalent circuit of simple $R-CPE$ parallel connection.

T/°C	-80	114	228
χ^2	0.0106	1.92E-04	0.0102
Sum-Sqr	1.12	0.00826	0.782
R/Ω	1.32E+12	1.14E+07	1.578E+09
Error/%	2.60	1.53	9.26
$CPE-T$	1.13E-11	2.04E-10	4.97E-11
Error/%	0.428	1.17	2.48
$CPE-P$	0.985	0.813	0.881
Error/%	0.0696	0.124	0.299

Table. S 2 Fit results for the spectra in Figs. S4, S2 and S6 of the sample with x=0.75 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ using the equivalent circuit of simple R-CPE parallel connection.

T/°C	-35	35	120
χ^2	0.0582	0.0121	0.000157
Sum-Sqr	5.76	0.911	0.00486
R/Ω	1.58E+08	8.73E+07	8.82E+05
Error/%	17.1	5.55	1.93
$CPE-T$	3.61E-11	2.46E-10	2.11E-9
Error/%	0.531	4.35	2.26
$CPE-P$	0.578	0.804	0.715
Error/%	0.352	0.540	0.2538

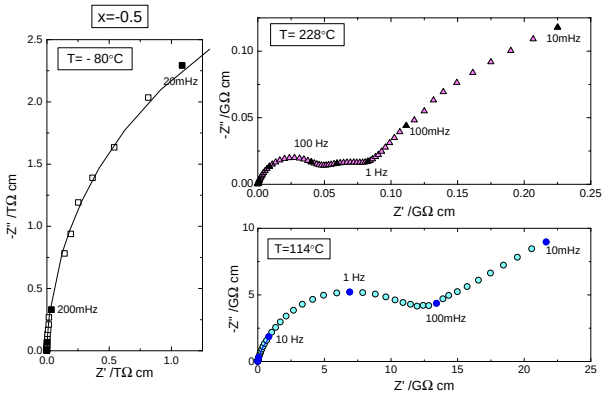

Fig. S 1 Impedance spectra of the sample with x=-0.5 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -80, 114 228°C. The lines are the simulation using the fit results of Table S1 for the partial spectra in the high frequency range.

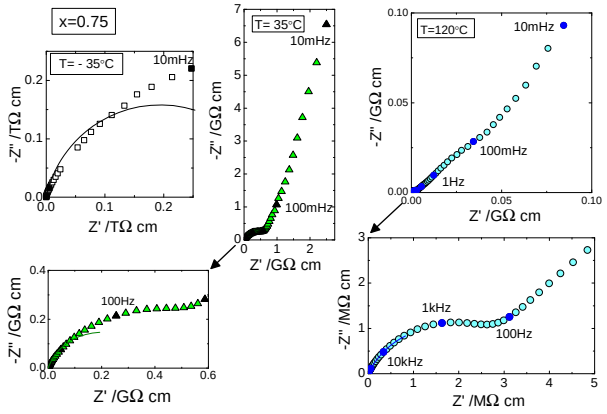

Fig. S 2 Impedance spectra of the sample with x=0.75 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -35, 35, and 120°C. The lines are the simulation using the fit results of Table S2 for the partial spectra in the high frequency range.

[a] *School of Materials Science and Engineering, Chonnam National University, Gwangju 500-757, Korea. Fax: 82 62 530 1699; Tel: 82 62 530 1701; E-mail: jongsook@jnu.ac.kr*

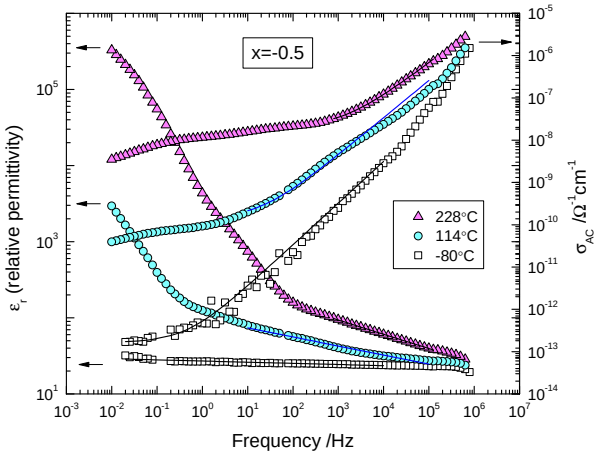

Fig. S 3 Relative permittivity ε_r and ac conductivity σ_{AC} of the sample with x=-0.5 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -80, 114, 228°C. The lines are the simulation using the fit results of Table S1 for the partial spectra.

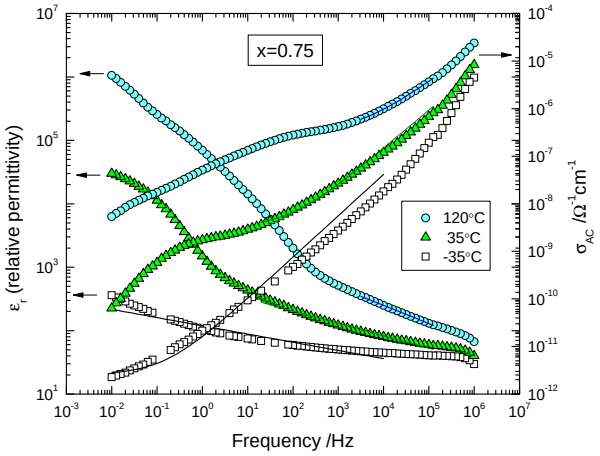

Fig. S 4 Relative permittivity and ac conductivity of of the sample with x=0.75 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -35, 35, 120°C. The lines are the simulation using the fit results of Table S2 for the partial spectra.

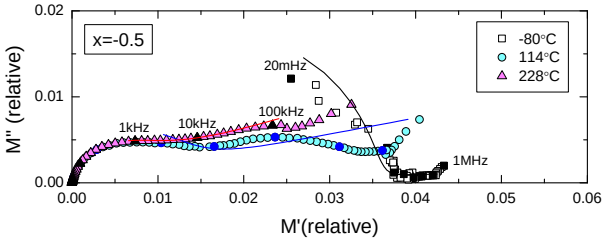

Fig. S 5 Modulus spectra of the sample with x=-0.5 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -80, 114, 228°C. The lines are the simulation using the fit results of Table S1 for the partial spectra.

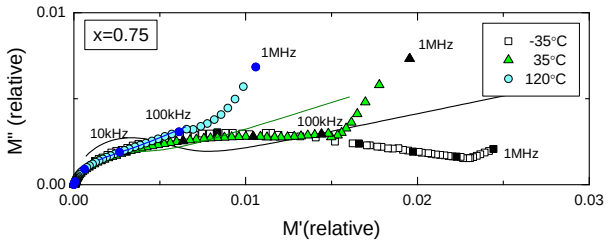

Fig. S 6 Modulus spectra of the sample with the sample with x=0.75 in $La_{9.33+x}(SiO_4)_6O_{2+3x/2}$ at -35, 35, 120°C. The lines are the simulation using the fit results of Table S2 for the partial spectra.